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THE SURGICAL TREATMENT OF PRESIDENT GARFIELD.

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It has been asserted that the unfortunate termination of the President's illness was due to one of the three following causes:

First. The necessarily mortal character of the wound.

Second. The imperfect development of the science of surgery.

Third. The disregard by the attending and consulting surgeons of well-recognized principles of surgery, which, if acted upon, would have diminished or abolished the tendency to death.

The short space in this journal at my disposal will only admit of a very cursory examination of these points, while many others of great importance must be passed over altogether.

First. Was the wound necessarily mortal?

It appears that the ball, after fracturing the eleventh and twelfth ribs,—the former in two places,—continued directly on in its course without marked deflection, and, striking the spine obliquely, passed through the intervertebral substance between the twelfth dorsal and first lumbar vertebræ, cutting a groove in the latter, and lodging on the left side of the spine, below the pancreas and outside of the peritoneal cavity.

The spinal cord received no injury beyond a slight concussion, which was recovered from in a couple of days.

No important vessel was injured, and all the abdominal organs escaped.

Now, where are the elements of inevitable death as the result of such a wound?

Jobert de Lamballe* says :

“Although the ball may have traversed the body of the vertebra in its anterior part, and although it may have caused paralysis, we should still trust to the infinite resources of nature. * * * We have seen fractures of the vertebral column, with compression of the spinal cord and paraplegia, recover rapidly, and to an extent greater than would have been supposed. I recall with pleasure a patient who was treated at the Hospital Saint Louis, about eleven years ago, when I was there in the service of my illustrious master, Richerand. The man had a fracture of the lumbar region and complete paralysis * * * but he was almost entirely cured.”

Surgeon-General Longmore,† of the British army, says :

“Balls have been known to pass through the bodies of the vertebræ and apparent cure follow.”

Lidell,‡ one of the most experienced of our military surgeons during the late civil war, states that of ten cases of gunshot fractures of the bodies of the vertebræ without injury of the cord, four recovered.

But one of the most instructive cases on record is that reported by Dr. F. H. Hamilton. A soldier was wounded March 16th, 1865, the ball “perforating or possibly grooving the anterior surface of the body of the second lumbar vertebra.” In September, 1865, a small fragment of bone escaped. In September, 1867, Dr. Hamilton found him suffering only with a slight paralysis of the bladder. The ball was found lying in the muscles on the other side of the spine, and Dr. Hamilton cut it out. Since then, it is stated that recovery is complete. Dr. Hamilton took the man before the New York Pathological Society, and he says: “The members present concurred with me in my opinion that the ball had struck the body of the vertebra.”

Many other authorities to the like effect might be cited, but they are probably unnecessary.

As to the injury to the ribs, no civil or military surgeon will venture to affirm that gunshot fractures of the ribs uncomplicated with lesions of the abdominal or thoracic viscera are necessarily fatal. It appears to me, therefore, and I think the great majority of civil and military surgeons will agree with me, that, while the President's wound was a serious one, there was not a

* *Plaies d'armes à feu*, etc., Paris, 1833, p. 123.

† *A Treatise on Gunshot Wounds*, Philadelphia, 1862, p. 76.

‡ *American Journal of the Medical Sciences*, vol. lxxviii., p. 317.

single feature or combination of features about it which rendered death inevitable.

Second. Was death due to the inchoate condition of the science of surgery?

In gunshot wounds, the science of surgery requires certain things to be done.

In the first place the relative positions of the assailant and the patient should, if possible, be ascertained. As thorough an examination of the wound should be made, for the purpose of determining the course of the ball and its situation, as the case requires. There is no possible condition which can stand in opposition to this precept, though there may be such an existing state of the patient as to cause the examination to be deferred for a few hours. Such cases are, however, exceedingly rare. Then all foreign bodies, such as pieces of clothing, spiculæ of bone, etc., should be removed from the track of the wound as soon as discovered, and the bullet itself should be extracted if its removal can be effected without the infliction of serious additional injury. All fractured bones should be adjusted, and, if necessary, their rough ends removed. All these things should be done under antiseptic conditions, and antiseptic dressings should be applied. There is more necessity for such precautions during the first forty-eight hours than during all the rest of the period of treatment.

If after thorough examination it should be found that the ball has entered the brain, or heart, or liver, or other vital organ, or is lodged in one of the great cavities of the body, further interference is in general unjustifiable. But such fact can in many instances only be ascertained by an exploration conducted by a skillful surgeon, and with every precaution to guard against being deceived. It is in no case to be deduced from a hurried and superficial insertion of a finger or probe into what may at first sight be deemed the track of the bullet.

I cite a few modern authorities on these points.

Surgeon-General Longmore says:

“On arrival at the hospital, where comparative leisure and absence of exposure afford means of careful diagnosis and definitive treatment, the following are the points to be attended to by the surgeon: firstly, examination of the wound with a view of obtaining a correct knowledge of its nature and extent; secondly, removal of any foreign bodies which may have lodged; thirdly, adjustment of lacerated structures; and fourthly, the application of

dressings. The diagnosis should be established as early as possible after arrival at hospital. An examination can be made with more ease to the patient and more satisfactorily to the surgeon than at a later period. * * * One of the earliest rules for examining a gunshot wound is to place the patient as nearly as can be ascertained in a position similar to that in which he was in relation to the missile at the time of being struck by it. In almost every instance the examination will be facilitated by attention to this precept."

M. Legouest,* professor of clinical surgery in the military medical college at Val de Grace, says :

"The first thing the surgeon who is called to a case of gunshot wound should do is to explore the wound. The injury may involve a part of the body habitually uncovered, or one protected by clothing or by some provisional dressing. When the wound has been exposed to his inspection, it should be immediately explored; and when the part is concealed by the dress, this should be removed to such an extent as to permit of exploration being accomplished with the most complete facility. * * *

"The exploration is made by the sight and by the touch. The eye shows the region wounded, the number and form of the wounds; it permits us to appreciate, in a general manner, the direction followed by the projectile, to perceive the normal configuration or the deformation of the parts, and their coloration; it gives some information in regard to the organs which may have been injured. By the touch we determine the hardness and softness of the wounded parts, their temperature, the more or less acute pain of which they are the seat, the absence or the existence of movements of various kinds, of fluctuation and of crepitation. It is not sufficient to see and touch the wound and the neighboring parts; it is necessary to push the investigations to the greatest extent, and to make, at the same time, a general and rapid examination of the patient, in order to ascertain the symptoms which may be present. It is after having fulfilled these preparatory requirements that the surgeon proceeds to the exploration of the track of the wound.

"It is an invariable and absolute rule that, when the course of a bullet is to be determined, the patient should be placed in the position which he occupied when he received the wound. The situation of the patient relative to the enemy or to his adversary, and any movements which he may have performed, ought to be perfectly known to the surgeon, and reproduced before him, if it be possible. These preliminary precautions, which are often indispensable for arriving at a correct diagnosis of the track of the ball, are also of the greatest importance in pathology and in legal medicine. * * *

"The finger is the best exploring instrument. * * * The fear of making the patient suffer pain, the apprehension that he may exhibit at the idea of an exploration which is brutal only in appearance, should never influence the surgeon. * * *

"Every-day experience confirms the wisdom and importance of exploration. Timid and inexperienced surgeons, or those too confident in themselves, may alone dispense with it. * * * Wounds should be explored as soon as possible

* *Traité de chirurgie d' armée*, Paris.

after the injury is inflicted. A delay of twenty-four or forty-eight hours allows of the production of an inflammatory swelling, which not only renders the parts more sensitive and consequently painful on exploration, but which interferes with its proper performance by reason of the diminution which results in the size of the canal, and by the increase in the volume and deformation of the wounded tissues. * * *

"Finally, exploration furnishes the greater number of the indications by which the nature of the wound is determined,—that is to say, whether it be simple, complicated, or threatened by accidents which we have designated accidents to be feared; and it furnishes the basis for the treatment that may be proper in the case. These advantages of the exploration of wounds without doubt counterbalance the inconveniences pointed out by opponents of the practice—inconveniences which the skillful and experienced hand will know how to avoid."

And what can be more explicit in regard to what surgical science requires than the following emphatic language of Professor Gross:*

"To ascertain the *condition of the wound* is a matter of the first importance, and yet it is one which, I am convinced from much personal observation, is often most grossly neglected. The object should be not only to determine whether there is any foreign substance, but what the actual condition of the soft parts and bones is; whether, in a word, excessive and irreparable injury has been inflicted, forbidding all attempts at surgical interference; whether primary amputation is demanded, or whether the treatment shall be wholly conservative. For the want of this precaution, many limbs and lives are lost, simply because what should have been done at once, at the earliest possible moment, is postponed until it is too late to be of any benefit. Many of the men that are sent from the battle-field to the hospital fall victims to erysipelas, pyæmia, gangrene, and secondary hemorrhage in consequence of the irritation produced by retained splinters of bone, shreds of clothing, or other hurtful matter that should have been removed on the spot. Such neglect, whether caused by ignorance, carelessness, or timidity, cannot be too pointedly condemned or too severely censured. It need hardly be added that, inasmuch as all explorations of this kind must be painful, the patient should always be thoroughly anæsthetized. Moreover, they should be instituted at the earliest possible moment, before the parts are invaded by inflammation and swelling, as they may then be conducted with comparative ease and without any serious ulterior harm.

"The fourth indication is the *extraction* of the ball. But to do this, it is necessary in the first place to ascertain where it is: to grope about in the wound without any definite idea as to its precise location would only be to inflict additional pain and injury. In order to conduct the examination with the greatest advantage, the part should be put as nearly as possible in the position in which it was at the time of the accident. This is the more

*A System of Surgery—Pathological, Diagnostic, Therapeutic, and Operative. Fifth edition. Philadelphia: 1872. Vol. 1, p. 391.

necessary because, as was before stated, the missile often pursues a very different route from what might be supposed from merely looking at the orifice of entrance or exit; the slightest resistance may change its direction and cause it to lodge at a point far beyond what it would have sought had it been permitted to pass in a straight line. Hence, attention to the position of the parts is in all cases a matter of the greatest importance."

And in regard to the treatment of the hemorrhage from which the President suffered for the first few hours after the infliction of the wound, and the management of the fractured rib, I will only make one quotation, and that will be from the excellent work of Dr. F. H. Hamilton:*

"It is seldom, even in gunshot fractures, that the intercostal artery bleeds sufficiently to require a ligature, but in case the hemorrhage from this source is alarming, and the artery cannot be tied in the usual way, or its bleeding be arrested by digital compression, it will be proper to cast a ligature around the entire rib on the side of the fracture nearest the spine, or even, in some cases, to excise a portion of the rib in order to reach and secure the bleeding vessel."

Nothing more is required, so far as I can see, to demonstrate what the science of surgery requires of its followers. Its precepts are of no uncertain tone; they are clear, decided, and to the point, and every surgeon should know them and act according to their teachings. Certainly the President did not die from any lack of positive principles applicable to his case. If there were no rules to suit a wound such as that of the President, the science of surgery would be a fraud, and the surgeons who, through past ages down to the present time, have become eminent in their calling, would have been unmindful of that debt which, as Lord Bacon declares, every man owes to his profession. They, however, have not failed in their obligation, and out of their accumulated experience surgery has been built up from a rough and imperfect system to its present advanced stage of development, with explicit rules for the management of every possible wound or injury. Were these rules heeded in the present instance? This question brings us to the third and last division of the subject.

Third. The surgeons in attendance and in consultation on the case are charged with certain neglects and mistakes, by reason of which the President died.

*The Principles and Practice of Surgery. Second edition. New York: 1873. P. 266.

While not prepared to assert, in the light of all the facts as revealed by the post-mortem examination, that this charge can be sustained in its entirety, I believe that the following alleged circumstances are true. If they are, then in so far as they are contrary to sound surgery were the chances of President Garfield's recovery lessened. But, whether true or not, I desire to express my profound admiration for the fidelity, devotion, and assiduity displayed by the attending and consulting surgeons. Rarely has any man, whether of high or low degree, had a more laborious and dutiful body of medical and surgical attendants than had President Garfield, and I believe that in no other country in the world could such entire abnegation of self as they exhibited have been obtained from physicians and surgeons in attendance on prince or potentate.

That the President lay for at least ten hours before any exploration whatever was made of the wound, other than the hurried examination made at the railway station.

That during all this time no serious attempt was made to arrest the hemorrhage which caused such alarming weakness.

That, acting upon the mistaken hypothesis that the ball had gone through his liver, it was announced to him that he had but "one chance in a hundred" of recovering, thus still further depressing his vital powers.

That, when made, the exploration was superficial, and based upon the erroneous theory that the assassin had stood directly behind the President, and that hence the bullet had entered the peritoneal cavity, traversing the liver, and lodging somewhere in the abdomen.

That, in accordance with this erroneous hypothesis, the patient was subjected to a rigorous antiphlogistic treatment, for the purpose of preventing the development of peritonitis, of which there was no real danger, and by reason of which his vital powers were still further reduced, and the liability to the occurrence of pyæmia greatly increased.

That no proper attempt was made to ascertain the presence of extraneous matters in the track of the bullet, the degree of fracture of the ribs, or to adjust the fragments; and that, in fact, the fracture of the twelfth rib was not discovered till after death.

That it was not till the 24th day of July,—twenty-one days after the reception of the injury,—when, in consequence of the occurrence of severe constitutional symptoms indicating the

existence of pyæmia, an incision was made for the exit of burrowing pus; that then the eleventh rib was found to be fractured in two places, and several pieces of bone and fragments of clothing, which had been driven into the track of the wound, were removed.

That, from the examination then made, it was judged that the bullet had not passed through the liver, but had been deflected by the rib in a downward direction toward the right groin; and that this theory was held and acted upon till death occurred, when the post-mortem examination demonstrated its erroneousness.

That at the autopsy it was found that what had been supposed to be the track of the ball was a pus cavity, formed by the burrowing of matter from the real track of the wound.

That there never was any adequate reason why a thorough exploration of the wound, with finger and probe, could not have been made within twenty-four hours after the shooting, and that the strong constitution of the patient and his remarkable powers of endurance prove that any necessary and proper examination could have been endured.

That had this been done, the track of the bullet would certainly have been discovered, as it had pursued a perfectly straight course, undeflected by any tissue through which it had passed. The injury to the ribs and first lumbar vertebra would have been ascertained; pieces of bone and of clothing would have been extracted, lessening the suppuration and consequent danger of pyæmia; and, though the ball would not probably have been reached, its approximate situation would not have been—as it was—a matter of guess-work.

That the failure to discover the real track of the ball, and to treat the fractured ribs, led to the burrowing of pus in the right inguinal region, and the formation of a sinus, which during life was supposed to have been made by the bullet.

That the error thus committed was one of cardinal importance, for had the real character of this passage been ascertained, not only would its progress have been stopped at once by appropriate measures,—position, bandages, compresses,—but means would have been adopted for causing it to heal. Mistaken as it was for the track of the ball, it was left open,—a large amount of pus was thus formed, the patient unnecessarily weakened, and the danger of pyæmia immensely increased. That there is noth-

ing in the revelations of the post-mortem examination to show that the pyæmic condition which evidently existed had any other source than this sinus which was supposed to be the track of the ball.

That pyæmia existed from about the 23d or 24th of July, as shown not only by the rigors, temperature, pulse, emaciation, delirium, and general prostration, but by the occurrence of metastatic abscesses in various parts of the body, as well as by purulent infiltration of the lungs. That from the 23d of July on, there was scarcely a hope of the President's recovery, not, however, from the alleged necessarily mortal character of the wound, but from the supervention of pyæmia, or septicæmia, if the term be preferred, in a patient already enfeebled to an extreme degree by insufficient food and otherwise bad hygienic conditions.

That the rupture of the splenic artery was either due to mal-nutrition of the coats, the result of pyæmia, or was post-mortem, being caused by the injection of a solution of chloride of zinc into the vessels several hours before the autopsy. If the latter was the case, the blood found in the peritoneal cavity was pushed out by this fluid, which of course filled all the vessels, and which, it is admitted in the report of the post-mortem examination, was extravasated into the abdominal cavity with the blood.

That the assertion that the splenic artery was injured by the ball is entirely unsupported by the evidence, there being nothing to show that the missile even touched it. Moreover, had it done so, it must have been with a degree of velocity altogether incapable of producing ill effects. It is to be borne in mind, also, that in the full report of the autopsy it is nowhere asserted that the rent in the splenic artery was caused by the bullet, nor does Dr. Bliss,* in his "Report," make such claim. It was reserved for gentlemen who had had no connection with the case during life to make the discovery.

That if the large clot came from the splenic artery, where did the small one come from that was found in the omentum, and which, it is stated in the official report, had no communication with the splenic clot? Two distinct clots show the existence of two ruptures, both of which were probably of pyæmic origin, or caused by the chloride of zinc injection.

* Medical Record, Oct. 8th, 1881.

That the fact that no clots were found in the heart was due to the same cause, the filling of the organ with chloride of zinc solution, and the consequent displacement of the blood.

That the phenomena of death were not such as would have been produced by hemorrhage, and that the explanation given in the account of the post-mortem examination of the cause of the pain is entirely insufficient.

That death probably was directly due to the formation of a thrombus or clot in the heart, or to embolism, and that the pain was really in the heart, as the patient declared.

And finally, to sum up the main conclusions, it is denied that the wound was necessarily a mortal one; it is denied that the science and art of surgery are in such an imperfect state of development as to afford no certain rules for the treatment of a case like that of the President; and it is asserted that during the first forty-eight hours the surgical practice was not in accordance with well-defined and acknowledged surgical precepts, and that hence the President did not have all the advantages of treatment which modern surgery is capable of affording.

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DR. ASHHURST.

I HAVE been requested by THE NORTH AMERICAN REVIEW to express an opinion in regard to the injury of the late President Garfield, and in respect to the treatment adopted in the management of his case.

The condition of the President, when first wounded, was one of what surgeons call *shock*, developed in a marked degree. The essential nature of this condition is not, as yet, very well ascertained. Its phenomena appear to be due to paralysis of certain nerve centers which, from their presiding over the blood-vessel system, are called *vaso-motor*; but in what manner an injury, sometimes of a remote part of the body, causes paralysis of these centers, is by no means clear. Shock, which occurs in the lower animals as well as in man, may be—but is in no degree necessarily—accompanied by mental or emotional disturbance. The calmness, mental clearness, and perfect self-control of the President, at the time of and during the hours following his injury,

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constituted not the least remarkable feature of his case. Shock may be said to be the general or constitutional effect of injury; and, just as all the tissues of the body are united by the synergy of health in normal life and action, so are they still united by sympathy under the effect of injury, and one cannot suffer without the others.

One of the complications of shock most to be dreaded is hemorrhage, and the surgeon must always be on his guard in a case of severe wound attended by shock; for, as this condition passes off, the force of the circulation is increased, and bleeding—which under these circumstances is called reactionary bleeding—is apt to occur. It will be remembered that not only was there rather free bleeding from the President's wound, during the day and night following its infliction, but that once or twice during the same period the symptoms were such as to cause the fear that internal or concealed hemorrhage was taking place.

Leaving aside, for the present, the question of treatment, we find that reaction, in the President's case, though very slow, was finally established, when the fear of an immediately fatal issue was no longer entertained. The progress of the case for some time was now fairly satisfactory, though the daily rise in temperature, continuing after the period at which simple traumatic fever ordinarily subsides, showed that, to a certain degree, septic absorption was constantly going on, while the very limited amount of nourishment which the patient was able to retain and assimilate rendered it certain that he would gradually become weaker under the combined influence of insufficient food and exhausting suppuration. The first seriously alarming complication which occurred was the formation of a large pocket, or pouch, containing pus, which could not be thoroughly evacuated through the original wound. The formation of this new focus of suppuration was marked by the occurrence of severe chills, or rigors,—always an alarming symptom in surgical cases, as being one of the most prominent manifestations of that form of blood-poisoning which is known as pyæmia, though fortunately often due simply to the recurrence of former malarial symptoms, or, as it proved in the President's case, merely evidence of the formation of an abscess in an accessible situation. A counter-opening, made in a more dependent position, by affording free drainage relieved the threatening symptoms, and, several shreds of clothing and fragments of bone (from a rib broken by the assassin's

bullet) having been removed a day or two subsequently, no further material trouble was experienced in securing free evacuation of the pus as it was formed in the deeper parts of the wound, though a fortnight later an enlargement of the incision was required.

For a time, everything now seemed to be progressing favorably, in spite of a rather persistent attack of vomiting, possibly connected with the use of an anæsthetic on the occasion of the second operation, until the report was made that a swelling had appeared in the region of the right parotid gland. Like the cloud no bigger than a man's hand, which yet announced to the prophet the onset of the coming storm, this simple statement excited in the minds of surgeons who had studied the daily bulletins of the case, the gravest apprehensions for the future. While parotitis, occurring either as a simple inflammatory affection or in the epidemic form as mumps, is ordinarily a trifling affair, the hard, brawny swelling which is known as the "parotid bubo," and which is met with in low states of the system, and as a complication of septic poisoning, is, though rare, an exceedingly grave, and very often a fatal, condition. Of three cases which I at this moment recall, seen in consultation with other surgeons, two ended in death—one from the intensity of septic infection, and one from hemorrhage, due to ulceration involving the internal jugular vein. As the parotid disease ran its course in the President's case, he again fell into a condition of great and imminent danger, as evinced by profound prostration, occasional wandering delirium, and intense irritability of stomach, which for several days required the abandonment of all attempts to administer food by the mouth, and necessitated the use of nutrient and stimulating enemata, as a means of averting threatened dissolution.

Again the illustrious sufferer rallied, and then, as soon as it was deemed safe, and at his own urgent and repeated request, he was transported with the utmost care from the presidential residence in Washington, whither he had been carried immediately after his injury, to a favorably situated cottage at Long Branch. Here, although the patient had borne the journey well, and had evidently profited by the change of air and location, a new complication was ere long developed. This was pulmonary congestion, deepening into inflammation, the pneumonia being evidently of the variety which physicians designate as hypostatic—due to

the accumulation of blood in the depending portions of the lung, and met with in depressed conditions of the system, in which the patient is unable readily to change his position, as after low fevers. In the President's case, the exhaustion from prolonged suppuration and the general septic state which existed obviously favored the occurrence of hypostatic congestion and engorgement.

From this time, the progress of the case appears to have been downward. In a few days rigors recurred, and were repeated at irregular intervals; and then came sudden and acute abdominal pain, collapse, and death.

A post-mortem examination showed that the ball, having entered over the tenth intercostal space on the right side, had, after fracturing the eleventh and twelfth ribs, been deflected from its course, and had passed downward through the body of the first lumbar vertebra, and had lodged on the left side, below the pancreas, where it had become thoroughly encysted. A long, suppurating channel, extending almost to the right groin, had been, during the President's life, supposed to be the track of the ball; but was now shown to be merely a sinus, resulting from the burrowing of pus. The immediate cause of death was found to have been secondary hemorrhage into the peritoneal cavity, from an artery (the splenic) which lay in the course of the original wound. There was a large abscess below, but not involving, the liver, and apparently not communicating with the wound. It was connected with the gall-bladder, and contained pus mingled with bile. One small abscess was found in the left kidney, and in the right kidney were three small serous cysts. The liver was enlarged and fatty, but presented no evidences of acute disease. The spleen was large and soft. The lungs and bronchial tubes were inflamed, as had been recognized during the patient's life; but contained no pyæmic patches, or, as they are often called, metastatic abscesses. The heart contained no clots.

The questions of most interest in connection with this sad case have regard to the matters of diagnosis and treatment.

First, as to diagnosis: The course of the ball was erroneously supposed to have been downward and forward toward the right groin. This was a mistake, but I confess that I do not see very well how the mistake could have been avoided. During the first few days of the case, there had been a suspicion that the spinal column might have been injured, on account of certain

nervous symptoms, numbness, etc.; but these soon passed away, and might readily have been due to injury of the spinal nerves after their emergence from the vertebral canal, or to spinal concussion without obvious and direct lesion. The digital and instrumental exploration of the wound made by the surgeons first in attendance had shown that the bullet had passed through the deep muscles of the lumbar region, and out of reach; and when, after the swelling which always occurs as the result of such an injury had subsided, a suppurating track was found corresponding in its course with the direction of the external wound, what more natural than that it should be supposed to be a part of the original wound itself? This belief was, of course, strengthened by the results of the electrical tests employed, by which it was thought that the position of the ball was indicated; but it is to be observed that, though no doubt some of the President's attendants were more confident than others that the ball had been discovered, none of them seem to have been so entirely sure of its location as to have been willing to recommend an operation for its removal.

Did the President suffer from malaria? To this question the only answer that can be given is that there was no evidence to warrant such a supposition. There were chills, no doubt, and periodic fever; but these were evidently both due to the wound and its essential complications, and there is no reason to import a hypothetical cause into the case to explain effects which are otherwise fully accounted for.

Did the President suffer from pyæmia? The answer to this question depends somewhat upon the meaning attached to the term. The name signifies "pus in the blood," but that is not what is meant when the term is employed by modern pathologists. Formerly, all forms of blood-poisoning which followed wounds were called pyæmic, but most surgeons now employ the word *septicæmia* as a general term, and limit the application of the name pyæmia to a particular form of blood-poisoning attended by repeated and irregularly recurring rigors and great variations of temperature, during life, and characterized by the presence of so-called "metastatic abscesses," found principally in the lungs and liver, after death. Using the term in this sense, as, I repeat, modern surgeons commonly do, there is no evidence that pyæmia existed in the President's case. The ranges of temperature-variation were not great, and after the chills

which accompanied the formation of the first abscess, there was freedom from this symptom until shortly before death. The chills which recurred during the last days were probably connected with the formation of the abscess which was found below the liver, and which, had life been prolonged, would probably have opened of itself into the wound. At the same time it is possible, though I think not probable, that these last chills were really pyæmic, and that, had the patient survived a few days longer, metastatic abscesses would have been developed. The abscess found in the left kidney is much more likely to have been dependent on local disease of the urinary apparatus than on any general infection. My answer, then, to this question is, that there is no evidence that the President suffered from pyæmia.

Turning now to questions of treatment, should the attending surgeons, when first called to the case, or at any time subsequently, have made an effort to remove the ball? I think not. Careful digital and instrumental exploration of the recent wound showed that the ball had passed beyond reach, and in view of the very grave general condition of the President, no further exploration would, in my judgment, have been justifiable. And afterward there was every reason to believe that the ball was becoming encysted (as, indeed, was the fact), and that all the harm that it was capable of doing had been done, and that its presence would be the source of no additional danger. Nor, indeed, would it have been possible, I think, to find the ball, by any means known to surgery; the autopsy showed that, in traversing the fractured rib, the bullet had, as it were, turned a corner, and was lodged in a position where it certainly would never have been looked for. To find a needle in a hay-stack is, no doubt, a possible though a difficult task; but the attempt has at least the advantage that it involves no greater risk than a fruitless expenditure of time and patience upon the part of the searcher. But to find a lost bullet in the soft tissues of a man's abdomen is a very different matter. To consider but a single point: death eventually resulted from an artery giving way in proximity to the wound, and from the blood bursting into the peritoneal cavity; or, in other words, from secondary hemorrhage and from peritoneal rupture. How long and how thoroughly could the surgeons have probed and explored the President's wound without causing primary hemorrhage, and without endangering the integrity of the peritoneum?

Did the President receive sufficient nourishment? This question I must answer in the negative. My allowance for hospital patients after severe wounds or operations, when they can take only liquid food, is five pints of milk daily for an adult, and three for a child. The President was certainly insufficiently nourished throughout almost his entire illness. But whenever an attempt was made to increase his diet, his stomach rebelled, and the supply of food had to be again diminished. All the nourishment was given that could be retained and assimilated, and the great and strong vitality of the man was shown in nothing more than in the fact that he lived so long with so little for life to be sustained upon.

Ought a more persistent attempt to have been made to render the wound aseptic? I am not, individually, an advocate or great admirer of what is called "Listerism," and do not think that such an attempt would have been judicious. The antiseptic method, as far as it was adopted, certainly did not either avert death or prevent septicæmia, and though the followers of Professor Lister would probably maintain that it failed because it was not carried out in all its details, I confess that I should have been unwilling, had I had the responsibility of the case, to make any further efforts in this direction than were made by the surgeons in attendance. I believe that the disturbance of the wound, which would have been unavoidable in an attempt to render it completely aseptic, would have done more harm than asepticism would have done good.

Finally, was the President's wound necessarily a fatal injury? The answer to this question must be somewhat qualified. Given a case precisely like the President's, and it must no doubt terminate in death; but the case might be different while the wound was similar. Certain wounds are *per se* necessarily fatal; such are extensive wounds of the aorta or vena cava, most wounds of the heart, wounds of the upper part of the cervical spinal cord, etc. But a gunshot fracture of the lumbar vertebræ, though an extremely grave injury, cannot be placed in the same category. If the President had been a youth of twenty, instead of a man of fifty; if all his organs had been perfectly healthy (his liver was enlarged and fatty, and his kidneys probably diseased); if he had been entirely free from care and anxiety, and not worn down as he was by the trials and dreadful responsibilities of his high office; if he had been able, all through his illness, to consume

and digest an ample quantity of nutritious food ; with the same wound, and with the same skillful and unremitting care on the part of his medical advisers and attendants, the case might possibly, though not probably, have terminated differently. To which series of "*ifs*," his attending surgeons might very properly reply that *if* by a strange convulsion of nature the sky should descend in sufficient proximity to the earth, no doubt the capture of larks would be more readily effected than it is at present.

Looking at the whole case, from beginning to end, I do not see that the treatment could have been altered in any way to the advantage of the illustrious patient ; nothing was done that should have been omitted, and nothing was left undone that could possibly have been of benefit.

JOHN ASHHURST, JR.

DR. SIMS.

THE President died of septic infection of the blood. It was blood-poisoning, whether called pyæmia or septicæmia.

The source of this infection is the subject of inquiry.

"The ball entered the body on the right side, at a point three inches and a half from the spinous process of the first lumbar vertebra. It fractured the eleventh rib, was then deflected downward, fracturing the twelfth rib, and passed across the axis of the body through the spinal column, in front of the spinal cord. It fractured the body of the first lumbar vertebra, and drove a number of small fragments into the adjacent soft parts. And it lodged about two inches and a half to the left of the spine, below the pancreas and behind the peritoneum, where it was found completely encysted."

The post-mortem showed that the ball was, and had been for a long time, completely encysted. It was, therefore, harmless, and must be eliminated from the list of agencies supposed to have produced the septic condition of the blood.

The track of the ball from its cyst back to the vertebræ was obliterated for half the distance (about one inch), while the other half contained a simple coagulum of blood without pus. As there were no septic agents at work here, this, too, must be set aside from the list of possible septic sources.

Between the fractured ribs and the fractured vertebræ there was an abscess cavity of irregular shape, capable of holding,

perhaps, an ounce. From this cavity a narrow pus channel extended downward by the kidney, behind the peritoneum, into the right iliac fossa (the inner surface of the hip bone), capable of holding an ounce more.

This was, during life, supposed to be the course of the ball. These pus pouches, communicating with each other, had been washed out twice a day with antiseptic lotions. They were thus kept empty and clean. At the autopsy they were found quite free from pus. They were a possible source of infection. But, as they were continually kept empty and disinfected, there is every certainty that they did not exert any appreciable evil

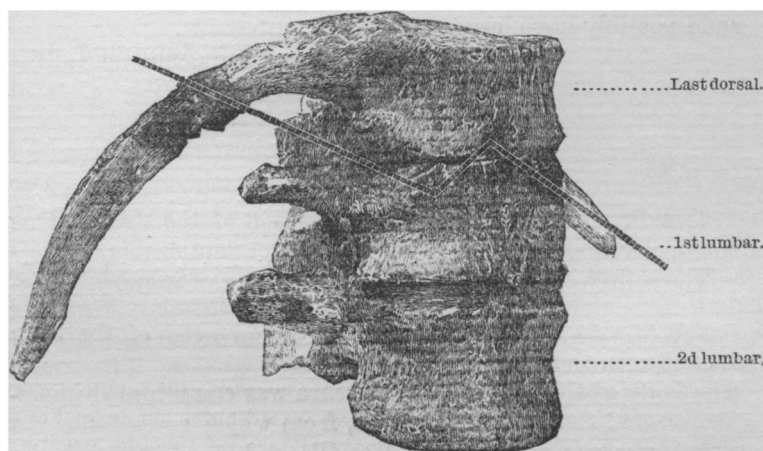


Fig. 1.

influence over the result. Indeed, if these two little pus pouches had been the only sources of blood-poisoning, the President would have been up in a fortnight or three weeks, and, with irrigation and cleanliness, he could have gone on for years without any serious inconvenience. So we may drop these from the possible sources of infection.

There remains, then, only the condition of the fractured vertebræ to be considered.

Figure 1 represents the last dorsal and the first and second lumbar vertebræ. The dotted line shows the course and direction, the entrance and exit, of the ball.

The ball fractured the right eleventh rib, and was then deflected downward, fracturing the twelfth rib. It then struck

the right side of the body of the first lumbar vertebra, and was deflected upward through the intervertebral cartilage into the body of the twelfth dorsal vertebra, where it was again deflected

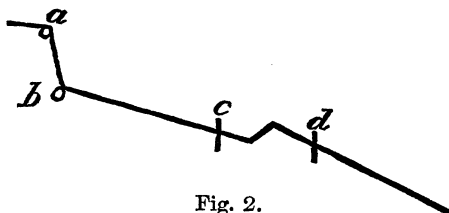


Fig. 2.

downward, and emerged from the body of the first lumbar vertebra at nearly the same angle at which it entered it.

Figure 2. This diagram shows the course and deflections of the ball. *First*, at the fractured ribs, *a, b*. *Second*, as it perforated the vertebra, *c, d*.

The ball, in passing, made a deep fissure in the anterior part of the body of the twelfth dorsal vertebra. It also split off two thin layers of bone from its lower margin, which, however, were held in position by the periosteum.

The ball was 42-100ths of an inch in diameter, and but little changed in its transit. The canal made by it through the spine was at some places a third larger than the diameter of the ball; at the exit a little more.

The body of the first lumbar vertebra was comminuted immediately around the track of the ball, from which several fissures extended into the intervertebral cartilage, between it and the second lumbar vertebra; the same condition existed in a minor degree in the last dorsal vertebra.

Figure 3 shows the vertebræ sawn open, longitudinally and nearly centrally. It is plainly seen how the cancellated structure of the first lumbar vertebra was shivered, and how the upper vertebra (the twelfth dorsal) was also badly injured. A large part of the intervertebral cartilage, between the first and second lumbar, and of that between the first lumbar and last dorsal vertebra, was destroyed by suppuration. And these two intervertebral spaces and the cancellated structure of the two broken vertebræ were full of ichorous pus.*

* Notwithstanding the proximity of these lesions to the spinal marrow, there was no evidence of inflammatory action in its structure or investing membrane.

This is what we call a compound, comminuted fracture; compound, because it had a vent externally; comminuted, because it was broken into little pieces. A compound, comminuted fracture, wherever situated, is always a serious affair. But when it involves the spine, it is the worst of all fractures. It is difficult to protect the system against the dangers of a compound fracture, even when we know all about it, and can have access to it. Its danger consists in the inflammatory action necessary for repair. Where the injury is extensive and deep-seated, giving rise to free exudation of vitiated pus, death is rapid. Where there is but a small quantity, the system is more slowly infected, and death ensues from gradual blood-poisoning. Pyæmia is more readily produced by injury of bones than by injury of soft parts.

First. Because septic matter is more easily dislodged from the latter than from the former.

Second. Because the inflammatory products of bone are more readily absorbed by its open venous sinuses.

The source of infection was, then, the injury and consequent inflammation of the vertebræ. The poisonous pus there generated was small, and the infection was slow, but none the less sure.

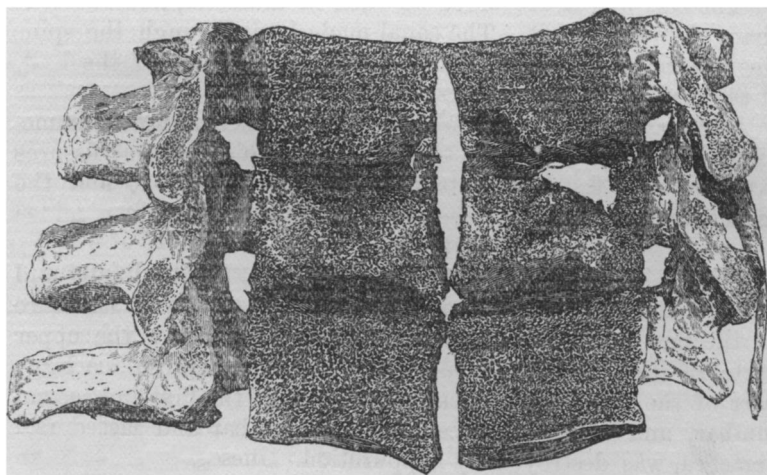


Fig. 3.

The immediate cause of death, or rather the manner of death, is supposed to be by rupture of a false aneurism of the splenic artery. Some think that the artery was wounded by the impact

of the ball at the moment of the injury. Others say: If the splenic artery had been opened at the moment of injury, the blood would have run out at the point of least resistance, which would have been in the direction of the track of the bullet, back to the spine. But this track was found at the autopsy to be obliterated. Therefore, the weakened coats of the artery must have given way at a later period. The everted edges of the slit in the splenic artery were united by firm adhesions to the adjacent connective tissue. Therefore, the rupture of the artery may have happened during the act of embalment.

I have been asked by a layman, a great jurist and statesman (Senator Edmunds), "Why does wound of bone produce more dangerous sepsis than wound of soft parts?"

The answer is simple. Veins, when cut or lacerated, act as absorbents, and take up foreign matter, whether benign or poisonous, and carry it directly into the circulation.

The veins in soft parts (with two or three exceptions) are surrounded by a small amount of elastic and muscular tissue, and some veins have a longitudinal net-work of muscular fiber. Such veins, when cut or wounded, contract, close up by their natural contractility, and oppose thereby a barrier to the ingress of foreign substances.

The muscular coating is wholly wanting in the veins of cancellous structure of bones. And they lie in tortuous, bony canals, to the walls of which their thin coats are closely adherent. When opened by accident, they have no power to contract.

Hence, when bony structure is divided, or in any way wounded during life, these veins remain patulous, and thus absorb, in a purely mechanical way, the fat set free by the rupture of marrow cells; and in the case of gunshot, or other compound fractures, septic products of the wound are readily absorbed. As a consequence, more or less fatty embolism accompanies every fracture, even simple fractures, in which, however, it never produces any symptoms. In compound fractures a variety of serious symptoms have been attributed to fatty embolism. But the researches of Scriba prove that all of them belong to the septicæmic process, and are really due to septic products.*

It was unfortunate that a correct diagnosis could not have been made at once in the President's case.

* See J. Scriba: Untersuchungen über die Felt embolie. *Zeitschrift für Chirurgie*. Bd. xii., 1879-80, S. 118.

The deflections of the ball, as shown in Diagram 2, account in some degree for this. The ball passed into the body for perhaps an inch (*a*), then was deflected downward at a right angle for more than an inch (*b*), and then was deflected at another right angle toward the spine (*c*, *d*).

It will be seen how difficult, almost impossible, it was to probe such a rectangular, zigzag canal as the ball made in this case. And how could any one find the course of the ball if it were impossible to follow its track with a probe? In this case the probe could not be passed in any other direction than downward in the line of the ball's first deflection.

But if the course of the ball could have been ascertained, the result would have been precisely the same. The surgeons could only have kept the pus pouch between the fractured ribs and spine, and the one extending down into the pelvis, empty and clean. This they did all the time, as the history of the case and the autopsy show. They could have done nothing whatever for the results of the compound, comminuted fracture of the two vertebræ. From the very nature of this part of the wound, death was, sooner or later, inevitable.

Pyæmia was suspected by many long before there were any local evidences of its existence.

Its first unmistakable symptom was on the 22d of July, when there was a violent chill, followed by a pulse of 132, and temperature of 103. The frequent recurrence of chills with febrile exacerbations at irregular periods, proved beyond doubt its continued progress.

Its next tangible manifestation was the swelling, inflammation, and suppuration of the parotid gland.

Its next was in the lung complication. The collection of pus found between the liver and colon may or may not have been a pyæmic deposit. And so with the small abscess on the top of the left kidney.

If the President had lived a month longer, he would certainly have had several similar deposits in distant and various parts of the body. His natural strength of constitution was shown by its power of resistance to this gradual but universal blood-poisoning. But for the injury to the spine, the President would have recovered, and I must here repeat that with this injury it is a marvel that he lived so long.

The attending surgeons of the President have been severely and unjustly censured by some of the press, and even by some of the medical profession.

A correct diagnosis is essential to successful treatment. It is the basis of all treatment. But we may diagnose accurately, and yet our patient dies when the wound is mortal. We may fail to diagnose correctly and our patient dies, for the same reason, that the wound is mortal. In a mortal wound, the diagnosis, true or false, is powerless to save life. And so it was with the President. His wound was mortal, whether diagnosed correctly or not. And it is uncharitable and ungracious to blame the surgeons in the President's case for its fatal termination. They did all that men could do; all that the present state of science would permit; and all that could have been done, even if they had at first ascertained the course and direction of the ball. Medical science is not yet an exact one. It is in a transition state. Although it is progressing with wonderful rapidity, the time will, I fear, never arrive when such cases as the President's may be treated with any more certainty of success than at the present day.

Of fatal cases of gunshot wounds of the lumbar vertebræ, the Army Medical Museum at Washington affords many illustrations. And, judging from what we there see, it is altogether probable that no man has ever yet recovered from such a wound as the President had. Indeed, our whole medical literature does not contain a single well-authenticated case of recovery from such a wound.

Mr. Lincoln's wound was instantly fatal. Mr. Garfield's was as certainly mortal.

Men sometimes recover from wounds of the brain. Baron Larrey reported cases of encysted balls remaining for years in the brain without inconvenience. I know a gentleman (a Confederate soldier) who was shot during our war in the base of the brain, as Mr. Lincoln was. He is still living, with the encysted ball in the brain.

In the surgical history of our great civil war, we find recorded nineteen cases of balls lodged within the cranial cavity without causing immediate death. In many cases, missiles were extracted from the brain. Some of these recovered, and some died. Many survived perforating gunshot wounds of the brain, but in such a state of complete disability that death would have been preferable.

Thus it is seen that gunshot wounds of the brain are really less dangerous than are such wounds as the President's.

View the President's case as we may, he had not the least chance of recovery under any circumstances, or any treatment.

Without the wound of the vertebræ, it would have been impossible for him to die. With it, it was impossible for him to live.

J. MARION SIMS.

DR. HODGEN.

PRESIDENT GARFIELD was wounded at 9.20 A. M., July 2d, 1881, by a conical ball, $\frac{42}{100}$ of an inch in diameter; the assassin standing six feet behind and a little to the right, and firing just as the President was in the act of turning to the left.

"The ball penetrated the skin opposite the tenth intercostal space—four inches to the right of the spine—shattering the eleventh and simply breaking in two the twelfth rib, passing through the sub-pleural portion of the diaphragm, just above the right ligamentum arcuatum externum" (Weiss, in "Medical Record," August 8th, 1881). "It tracked through the connective and adipose tissue behind the superior portion of the right kidney and the twelfth rib to the spinal column. It pierced the attachment of the right *psaos magnus* muscle to the first lumbar vertebra."

"It was found that the bullet had penetrated the first lumbar vertebra in the upper part of the right side of its body. The aperture by which it entered involved the intervertebral cartilage next above, and was situated just below, and anterior to, the intervertebral foramen, from which its upper margin was about one-fourth of an inch distant. Passing obliquely to the left, and forward through the upper part of the body of the first lumbar vertebra, the bullet emerged by an aperture the center of which was about one-half inch to the left of the median line, and which also involved the intervertebral cartilage next above. The cancellated tissue of the body of the first lumbar vertebra was very much comminuted, and the fragments somewhat displaced. Several deep fissures extended from the track of the bullet into the lower part of the body of the twelfth dorsal vertebra. Others extended through the first lumbar vertebra into the intervertebral cartilage, between it and the second lumbar vertebra. Both this cartilage and that next above were partly destroyed by ulceration. A number of minute fragments from the fractured lumbar vertebra had been driven into the adjacent soft parts."

It was further found that the right twelfth rib also was fractured, at a point one and one-fourth inches to the right of the transverse process of the twelfth dorsal vertebra.

"On sawing through the vertebra, a little to the right of the median line, it was found that the spinal canal was not involved by the track of the ball. The spinal cord, and other contents of this portion of the spinal canal, presented no abnormal appearances. The rest of the spinal cord was not examined" (Post-mortem Examination, "Medical Record," Oct. 8, 1881).

"It emerged from the left of the spine, pierced the left psoas magnus muscle attachment, and entered a plane of connective and adipose tissue between the left kidney posteriorly and the left half of the pancreas anteriorly. It crossed the posterior surface of the pancreas obliquely to the left, and from above downward to its point of lodgment. It wounded the splenic artery in its transit across the pancreas" (Weiss, "Medical Record," October 8th, 1881), lodging "in the adipose connective tissue immediately below the lower border of the pancreas, and about two and one-half inches to the left of the spinal column, and behind the peritoneum" (Post-mortem, "Medical Record," page 400).

Doctor Bliss saw the President soon after the shooting, and says ("Medical Record," October, 1881):

"He presented the appearance of perfect collapse; the lines of expression were lost; there was extreme pallor, sighing respiration (about eight or ten per minute), pulse exceedingly small, feeble, and frequent, and ranging about 120 * * * he had recently vomited * * * while he was unconscious * * * large drops of perspiration stood upon his face and forehead, hands and forearms." * * * After being removed to the White House, "the pulse continued feeble, frequent, and extremely compressible, the respiration was slow and sighing, extremities and surface cold, with occasional vomiting and profuse perspiration over the entire body; voice husky." * * * Water was given in small quantities, frequently repeated. This was necessitated by the extreme thirst from which the patient suffered. * * * There was but little change in the condition of the patient, either in temperature, respiration, or pulse, until about eleven o'clock * * * the respiration became more frequent and easy; the pulse responded but little to stimulants; nausea and vomiting continued at intervals of thirty minutes during the entire day until 7 P. M., when it became less frequent, with less retching—in fact, being simply a regurgitation of the fluids of the stomach. This condition continued at longer intervals until six o'clock on the following morning."

At 5.30 P. M. (July 2d), "the clothing was removed from the body by being cut in such a manner as to prevent any motion or agitation, and to permit the more successful application of dry heat by warm flannels to the entire body. * * * At 10 P. M. the pulse was 158, temperature over 96.50, respiration 35, which was the most critical period attending the collapse. At 11.20 P. M. the evidences of reaction began to manifest themselves. Until 2 P. M. of July 3d, the variations of the pulse were comparatively slight, ranging from 104 to 120, the respiration being normal. * * * At the evening consultation, July 2d (7 P. M.), the opinion was expressed by some of the medical gentlemen invited to the case, that internal hemorrhage had taken place, and that he would not survive the night. * * * The symptoms of profound collapse were so grave that Surgeon-General Wales was induced to express

the opinion that the President was dying. * * * The opinion obtained, and was so expressed to the council, that internal hemorrhage was then taking place, and that the extreme prostration, and feebleness of the respiration, were due to that cause. * * * All the physicians visited the White House at 8 A. M. July 3d, for the morning consultation, agreeably to a previous understanding that such should be the case if the President survive the night." (Dr. Bliss, in "Medical Record.")

This portion of the history of the injury received by President Garfield is given in this condensed form, and thus connected, that the attention of the reader may be easily fixed on the condition that led to, and the prominent symptoms of, the profound shock that immediately followed the injury.

Dr. Bliss found him, a few minutes after the shooting, presenting "the appearance of perfect collapse; the lines of expression were lost, there was extreme pallor, sighing respiration (about 8 or 10 per minute), pulse exceedingly small, feeble, and frequent, and ranging about 120."

"The severity of the shock is indicative of the amount of the mischief inflicted" (Erichsen, Surgery, page 143). The profound shock, taken by itself, in a man robust, healthy, temperate, and self-possessed as President Garfield, indicated a very grave injury. Thus far, in point of time, the shock pointed only to the nervous exhaustion due to mechanical violence done the nervous system. After reaching the mansion, Dr. Bliss again writes, "Water was given in small quantities often repeated. This was necessitated by the extreme thirst from which the patient suffered." At 7 P. M. July 2d, Dr. Bliss says:

"The symptoms of profound collapse were so grave that Surgeon-General Wales was induced to express the opinion that the President was dying. * * The opinion obtained, and was so expressed to the council, that internal hemorrhage was then taking place, and that the extreme prostration and feebleness of respiration were due to that cause, and that the President would not survive the night."

So general was this opinion on the part of the physicians present, that the consultation proposed on the following morning was made conditional on the survival of the President through the night. Here is the strongest evidence that the collapse was becoming more profound, and this condition was based on the supposition that hemorrhage was then taking place. Simple shock, dependent on injury to the nervous system alone, is usually brief; if added to this nervous shock there be free hemorrhage,

the collapse will be prolonged. The thirst which demanded frequent draughts of water is still another evidence that the collapse was dependent in part on loss of blood. The wound of the splenic artery, the evidence of which was presented at the post-mortem examination,—in a false aneurism,—is sufficient to account for the prolonged collapse which came so near to terminating the life of the President within twelve hours from the receipt of the injury.

The instantaneous fall, the immediate unconsciousness, and the quick emesis while yet unconscious, find a ready explanation in the proximity of the upper lumbar ganglion of the sympathetic, the semi-lunar ganglion, and the solar plexus to the track of the ball, if indeed it shall not, on a more thorough examination, be found that one or another of these nerve centers and tracts was injured by the direct contact of the ball, or a splinter of bone from the fractured rib or vertebra.

To my mind, the escape from death within six hours after such extensive injuries in a locality so crowded with vital parts, is simply incomprehensible, and I feel quite sure that one less vigorous than President Garfield must have died from shock. The immediate unconscious vomiting can hardly be attributed to shock of the general system; for, though vomiting often occurs from general shock, it does not occur until the shock is passing off; this, on the contrary, occurred during the first moments after injury, while the patient remained unconscious; it must have been from a direct injury of the centers supplying the stomach. In none of the reports which I have seen is this first act of emesis described, so that I am permitted to infer that the contents of the stomach were ejected by the contraction of its walls, and not, as occurs generally, by the aid of the diaphragm and abdominal muscles.

“The President complained of a sense of weight and numbness, and subsequently of a tingling sensation and pain in the lower extremities, * * * with constant complaint of severe pains in the inferior extremities. * * * A hypodermic injection of an eighth of a grain of morphine and an eightieth of a grain of atropia was administered to control the pain of the extremities. * * * The use of morphine hypodermically in doses of sufficient quantities to control the pain in the extremities was advised. * * * At 10.45 P. M., July 3d, the pain and soreness in the lower extremities was measurably controlled by the administration of morphine. * * * On the evening of July 4th, the pain and hyperæsthesia had nearly disappeared, soreness of the feet supervening and continuing for some days.”

The above quotations from Dr. Bliss ("Medical Record," October 8th, 1881) point distinctly to disturbance of the spinal cord, and the following from the same source admits of a similar explanation:

"The urine was retained until 6 o'clock P. M. (July 2d), when * * * six ounces * * * were drawn."

The post-mortem report has the following: "The spinal cord and other contents of this portion of the spinal canal presented no abnormal appearance." If, then, the pain, hyperæsthesia, and soreness of the inferior extremities be attributed to the spinal cord at all,—as they must be,—this disturbance must be regarded as due to concussion rather than to lesions, which would leave permanent traces of the injury.

On page 395 of the "Medical Record," October 8th, 1881, Dr. Bliss uses the following language, in summing up the evidence which the medical gentlemen in attendance took into account in arriving at a knowledge of the parts injured: "Gradual subsidence or modification of pain and hyperæsthesia of the feet and scrotum." The post-mortem record holds the following language in speaking of the entrance of the bullet into the first lumbar vertebra: the opening was "situated just below and anterior to the intervertebral foramen, from which its upper margin was about a quarter of an inch distant." Assuming that the pain and hyperæsthesia of the scrotum were confined to the right side of the scrotum, we may consider that this was due to a disturbance of the branch from the last dorsal nerve which descends to join the lumbar plexus.

Dr. Shrady informs us ("Medical Record," October 8th, 1881, page 404) of a wound of the splenic artery and the formation of a traumatic aneurism, as follows:

"The wound of the splenic artery gave rise to a traumatic aneurism which undoubtedly commenced to form immediately, and it was the final rupturing of this sac into the cavity of the peritoneum which, as is now well known, caused the death of the patient, and satisfactorily explains all the symptoms during the last hours of his life.

"The ball was thoroughly encysted; and the portion of the track adjoining it, for a distance of an inch, was completely closed. The position of the blood-sac evidently accounted for both of these conditions. This aneurism, situated to the left of the spinal column, and between the latter and the ball, apparently pressed upon that portion of the track next the missile, and closed it. At the same time, as can be easily understood, the aneurism was thus

placed in the direct track of the ball. This is certainly a very significant fact in connection with the probably fatal results in case any extensive explorations of the bullet-wound had been attempted. The aneurism was lined by concentric layers of fibrine, which showed nature's efforts to obliterate the sac in the usual manner.

"The evidences that the sac had not formed recently were made clear by a study of its pathological conditions. The opening in the splenic artery was on the superior and posterior aspect of its tortuous trunk, directly in the track of the ball. The edges of this opening were sharply defined, but were gradually beveled to be incorporated with the walls of the attached blood-sac. This condition indicates that the coats of the artery were cut completely through, during the transit of the ball, and were not merely grazed and afterward opened by ulceration. It would thus appear that the aneurism was formed immediately after the injury, and at that time attained its full size. Besides, the sac itself was evidently of long formation, as was shown not only by the firm condensation of its tissue and its intimate attachment to the edges of the cut in the artery, but by the number and apparent age of the concentric layers lining it. The burst portion of this sac was on its left anterior aspect, where not only its walls but the different concentric layers were thinnest." ("Medical Record," October 8th, 1881.)

That the President did not die quickly from the wounding of the splenic artery, can only be explained by the influence which the nervous shock had in almost suspending the heart's action, and thus inducing a very tardy flow of the blood through the vessels, permitting the formation of a sufficiently firm clot to check the flow. This clot became the site of an aneurismal sac, with well-defined laminated walls, which effectually prevented a recurrence of the hemorrhage until the general lowering of the vitality favored the disintegration which finally softened and permitted a rupture of the sac, leading to a final hemorrhage which terminated the life of the patient.

We find in the shattered, spongy body of the first lumbar vertebra, as described by Dr. Shrady ("The body of the first lumbar vertebra presented the appearance of carious degeneration in the course of the wound, and as far as could be judged by an examination of the dried specimen, the intervertebral cartilages above and below it were involved in the same necrotic process"), the most advantageous conditions for the absorption of the products of decomposition which give rise to septicæmia; for we have here not only cancellated tissue of bone becoming carious, but a direct though tortuous communication extending to the suppurating track, which had a branch to the track which formed in the loose subperitoneal tissue leading to the iliac fossa,

which last was thoroughly washed through drainage tubes and thus kept sweet, while the other track connected with the shattered vertebra was not found, and was not thus kept free from putrefactive influences.

In gunshot wounds involving vital parts, the question of determining the position of the ball is a delicate one. I think that good surgery dictates that in case of a ball passing through the ribs, whether in the direction of the abdominal or thoracic cavity, the surgeon is not justified in passing a probe beyond the inner surface of the ribs; and that when a ball has passed beyond this point, it is practically lost to the probe. If the ball have entered the peritoneal sac, of course its track cannot be followed; and if it enter the loose cellular tissue that lies between the peritoneum and the muscular wall of the abdomen, the resistance offered by the loose tissue will be so slight that a probe may be passed into it in any direction with great ease,—so much so that no surgeon could be sure whether the probe had followed the ball or had made its own passage in the connective tissue. When, then, the surgeons had determined that the ball had passed through the muscular wall of the abdomen, the probe could be of no further service in determining the position of the bullet. They were therefore left to the rational symptoms to determine its track.

The sense of weight and numbness and, subsequently, the tingling sensation and pain in the lower extremities (see Dr. Bliss, page 393), without loss of voluntary motion in the parts below the injury, would indicate the injury of nerve trunks distributed to the parts in which sensation was disturbed, or to a shock of the spinal cord at the point of origin of the nerves supplying the tingling, painful, numb parts. The nerves passing near the track of the ball after passing the ribs, were those supplying the lower part of the abdomen, scrotum, and anterior parts of the lower extremities; and if the pain were in the left as well as the right extremity, the spinal cord must have been shocked, or the nerves given off from it going to the left extremity must have been injured. This would have left the impression in the mind of the surgeon that the ball had passed sufficiently near the spinal cord to cause a disturbance of that part, or sufficiently near the nerves given off from the cord, and going to a part of the inferior extremities, to disturb their filaments. Now, so far as disturbing the nerves on the right side is concerned, this

might have been accomplished by the ball passing downward toward the pelvis; but to disturb the left lower extremity, it, or some other foreign matter, must either have passed into the spinal column or beyond it, in such a way as to have injured nerves from both sides of the spinal cord.

On the 4th of July a consultation was held, during which—

“A careful review of the case from the time I [Dr. Bliss] first saw the President was given to these gentlemen, with the request that they, with the data before them, examine the case thoroughly, as though it was their own, and freely express their views of the character and gravity of the injury and the course of treatment of the case up to that time. I also gave them a detailed account of the explorations made in the wound, and the unsettled convictions then held as to the course of the missile and the organs involved in the injury. They individually examined the wound with great care. These examinations consisted in the introduction, in different directions, of probes, flexible bougies, in order, if possible, to determine the course of the ball. With the evidence developed by this personal examination, together with the complete history of the shooting of the President, and the progress of the symptoms for the first forty-seven hours, they proceeded to discuss the possible course of the ball, and organs involved, viz., whether it passed directly forward into or through the liver, or was deflected backward at a right angle so as to involve the spinal column, or downward behind the peritoneum toward the pelvic cavity. Carefully weighing all the evidences, the more prominent symptoms upon which the diagnosis was based are presented in the following order:—The relative position of the assassin to the President at the time of the shooting; the direction of the ball through the tissues so far as safe exploration could determine; gradual subsidence or modification of pain and hyperæsthesia of the feet and scrotum; the repeated unsuccessful efforts to pass a probe or flexible instrument more than one-half inch in any direction beyond the fractured rib, except in a direction downward, a little forward and anterior to the twelfth rib, a distance of about two inches. The fact also was considered that exploration had twice been made with the finger—once by myself soon after I reached the injured President, and subsequently by Surgeon-General Wales, of the Navy, on the occasion of the consultation on the evening of July 2d; and in each instance it was found impossible to successfully explore by that means beyond the inner border of the fractured rib so as to determine with accuracy the course of the ball, or even the condition of the tissues indicated by the end of the finger. Nor did they underestimate the significance of the profound shock, nor the unusual period of collapse which followed, and seemed to point to extensive lesion of important viscera. However, that the kidneys, intestines, and peritoneum were not immediately involved, was made patent by the unrestrained passage of normal urine at proper intervals, the spontaneous movement from the bowels of natural feces, the frequent discharge of flatus, and the absence of other symptoms of peritonitis. With all these facts before them, it was impossible to determine positively the course taken by the ball. The indications pointed to a downward course of

the ball into the pelvic cavity. Upon careful consideration of the foregoing facts, and of the opinions expressed by the distinguished council, we were inclined to recede from the opinion at first adopted regarding the supposed passage of the ball through the liver. The propriety of making extensive incisions and dissections so as to explore the fractured ribs and remove as much as might be necessary to reveal the true course of the ball, was duly considered. But the opinion was maintained that the favorable progress of the President thus far did not warrant any interference, and further, such an operation would seriously complicate the case, and diminish the prospects of recovery. The facts revealed by the autopsy confirm the wisdom of the course pursued. With this view all the surgeons concurred."

Under the circumstances, what could have been more unwise than to have made further explorations, either with the finger, probe, or knife?

On the 23d of July, a sac of pus was defined below the twelfth rib and underneath the latissimus dorsi muscle. "On August 18th, a slight tumefaction of the right parotid gland was noticeable" (Bliss, "Medical Record," page 396). Pus afterward found a discharge into the throat, and an external opening was made.

"On August 19th, a small slough was discharged from the lower pus-track, when the flexible catheter was readily passed downward a distance of twelve inches toward the right iliac fossa. This channel was kept free from accumulations by passing into it carbolic or permanganate water from the hand fountain heretofore described, at the same time carefully withdrawing the catheter, so as to avoid undue distension of the track" (Bliss, "Medical Record," October 8th, page 397).

The flexible probe had taken a direction downward after passing the ribs, and now a flexible catheter passed downward twelve inches toward the right iliac fossa,—and later, a distinct thickening could be felt through the emaciated abdominal wall, at a point corresponding to the supposed end of the sinus running downward. The pain, numbness, and hyperæsthesia of the lower extremities had entirely disappeared at this time, and under these circumstances it was reasonable to conclude that the ball had finally found its way to the bottom of the sinus which terminated in the right iliac fossa. While the surgeons were satisfied that the ball was in the right iliac fossa, and so situated that it could be removed had it really occupied that site, yet they were so convinced that the grave symptoms were not dependent on the sinus that coursed downward, or on the presence of the

ball at the supposed site, that they thought it not desirable to make a counter opening in the one or remove the other.

Besides the extracts above made from report of Dr. Bliss, the treatment consisted in the beginning of the use of morphine hypodermically to relieve pain and secure rest, and it is remarkable how small was the quantity required.

"It must be remembered that quinine had been given in tonic doses much of the time, and when periodicity was noticeable, sedative doses were administered for a period of twenty-four hours at a time" (Bliss, "Medical Record," page 397).

Strict attention was given to nourishing the patient.

In reviewing the history of the case of President Garfield, I can find no reason for adverse criticism of any part of the management. I do not find that anything that was done, either at the examination or in the treatment, tended to hasten death, or in any way to unfavorably influence the progress of the case. Any probing beyond the inner surface of the ribs I believe was of no value. It was never possible at any time prior to the post-mortem examination to have known of the existence of the sac of pus revealed at the examination, or to have known the existence of an aneurism of the splenic artery. Possibly a careful examination by auscultation might have indicated the existence of an aneurism, but the artery on which it was situated could not be known, or its relations determined. Had the site of the ball been known, it could not have been removed. Had the site, character, and relation of the aneurism been known, the vessel could not have been ligated. Had the presence of the pus cavity been recognized, it could not have been evacuated without hastening the fatal termination.

Finally, if the pus cavity had disappeared harmlessly,—if the aneurism had been spontaneously cured,—if the bullet had remained encysted,—the injury of the spine, with the carious conditions of the bones, and the ulcerating intervertebral cartilages, must have left the President a deformed invalid.

JOHN T. HODGEN.